Executive Summary

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ES.1 Introduction

The Tennessee Valley Authority (TVA) is conducting a comprehensive Reservoir Operations Study (ROS) to determine whether changes in how it operates the Tennessee River system would produce greater overall public value for the people of the Tennessee Valley. TVA, the U.S. Army Corps of Engineers (USACE), and the U.S. Fish and Wildlife Service (USFWS) have cooperated to prepare this Draft Programmatic Environmental Impact Statement (DEIS) for the ROS. Representatives of other agencies and members of the public participated in this process by attending public meetings and providing comments on the scope of the document. TVA also established two groups—a 17-member Interagency Team and a 13-member Public Review Group —to ensure that agencies and members of the public were actively and continuously involved throughout the study. As the lead agency, TVA is primarily responsible for the preparation of this document.

Following public and other agency review and comment on the DEIS, TVA will prepare a response to comments and a set of recommendations—the Preferred Alternative—which will be included in the Final EIS. The TVA Board of Directors (Board) will decide whether TVA's reservoir operations policy will be changed and the nature of the change based on the recommendations of TVA Staff. In addition to staff recommendations, the Board will consider the Final EIS (FEIS), public comments, and other factors. The Board will make a decision no earlier than 30 days following the notice of availability of the FEIS. The final decision will be documented in a Record of Decision and made available to the public. Decisions made by other federal agencies would be appropriately documented by the respective agency.

ES.2 Background

The Tennessee Valley Authority is a multi-purpose federal corporation responsible for managing a range of programs in the Tennessee River Valley (the Valley) for the use, conservation, and development of the water resources related to the Tennessee River. In carrying out this mission, TVA operates a system of dams and reservoirs with associated facilities—its water control system (Figure ES.2-01). TVA uses this system to reduce the risk of flooding, enable year-round navigation, supply affordable and reliable electricity, improve water quality and water supply, provide recreational opportunities, stimulate economic growth, and provide a wide range of other public benefits.

Public participation in the ROS EIS began in January 2002, when TVA mailed letters describing the ROS to over 60,000 stakeholders across the Tennessee River Valley and Power Service Area, including representatives of agencies and Indian tribes which might be affected or interested. On February 25, 2002, TVA published a notice in the Federal Register, indicating the agency's intent to prepare a programmatic EIS on its reservoir operations policy and inviting interested parties to comment on its scope.

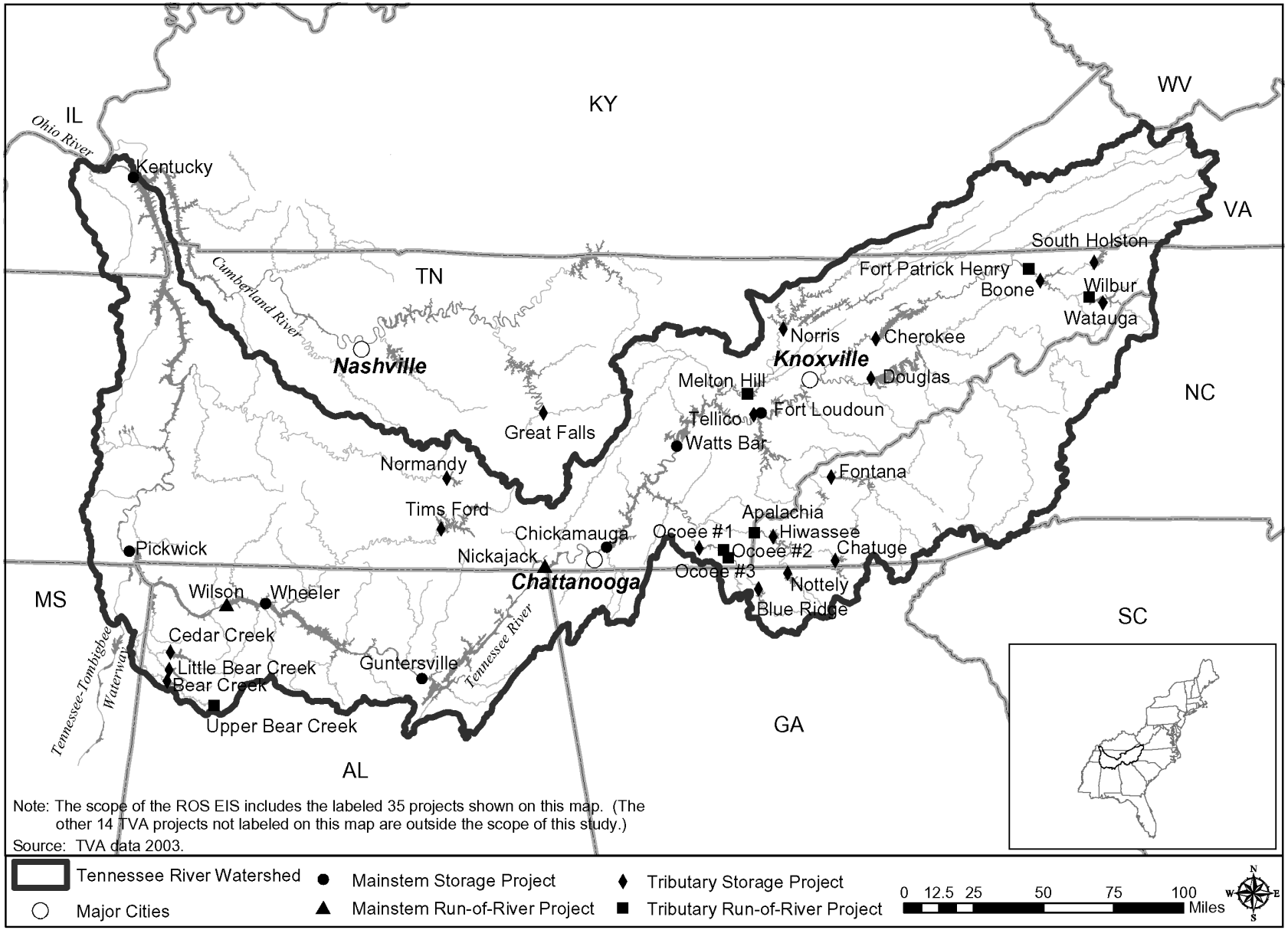

Figure ES.2-01 TVA Water Control System

During the 2-month comment period, more than 1,300 members of the public attended 21 community workshops held across the region, and several thousand wrote letters or submitted comments to TVA by mail, e-mail, fax, or telephone. When the comment period closed on April 26, 2002, TVA had received more than 6,000 individual comments, copies of form letters from approximately 4,200 individuals, and petitions signed by over 5,400 individuals. In addition, 3,600 residents in the TVA Power Service Area responded to a random telephone survey conducted by an independent opinion research firm in March 2002. The telephone survey was conducted with the unanimous recommendation of the Interagency Team and Public Review Group (IAT/PRG) to ensure that a representative cross section of the Valley's 8 million consumers had a voice in assigning operating priorities for consideration in the scoping of the study.

ES.3 Purpose and Need

The purpose of the ROS is to identify and evaluate the environmental and socioeconomic impacts of TVA's existing reservoir operations policy and alternative operations policies to the year 2030. Results of the ROS will show whether changes in the policy would produce greater public value. TVA's reservoir operations policy guides the day-to-day operation of the Tennessee River system. It sets the balance of trade-offs needed to maximize the beneficial, and sometimes competing, uses of the water in the system, subject to meeting the purposes of navigation, flood control, and power production. TVA's reservoir operations policy affects how much reservoir levels rise and fall, when changes in reservoir levels occur, and the amount of water flowing through the reservoir system at different times of the year. Changes in TVA's reservoir operations policy would modify the present balance among the various operating objectives for the system in response to changing public values. These modifications would result in different levels of emphasis being placed on various operating objectives.

TVA has undertaken this review as part of its overall mission and its commitment to evaluate the balance of public benefits that result from its reservoir operations. Analytical tools developed to perform the ROS constitute an investment in more advanced planning and modeling tools and technologies that will be used in operating the system with greater efficiency and reliability, irrespective of their applications for this EIS. The ROS was conducted in response to recommendations from public groups, individuals, and other entities such as the Regional Resource Stewardship Council, as well as recommendations from TVA's Inspector General and the Government Accounting Office report of May 1999.

The last major evaluation of the environmental and socioeconomic impacts of TVA's reservoir operations policy was included in the Tennessee River and Reservoir System Operation and Planning Review EIS, also known as the Lake Improvement Plan, which was completed in 1990. In 1991, the Board approved changes that included extending reservoir levels on 10 tributary reservoirs to August 1 in order to increase recreational opportunities. Following that evaluation, TVA continued to receive requests for changes to reservoir levels and other operations. As more and more users requested studies for their particular reservoir or tailwater, TVA decided that a piecemeal approach raised questions of fairness in how each reservoir would be treated. A comprehensive review was needed to examine the effects of changes in the reservoir operations policy on all of the operating objectives for the system across the entire TVA region.

ES.4 Scope of EIS

TVA owns and operates[1] 49 dams and reservoirs (called projects) in the Tennessee River and Cumberland River watersheds. The scope of the ROS EIS included evaluating the operations of 35 of these projects—projects for which TVA schedules water releases and reservoir levels in accordance with its reservoir operations policy.

The geographic area potentially affected by changes in the reservoir operations policy includes the Tennessee River watershed and the larger TVA Power Service Area. This area covers almost all of the state of Tennessee and parts of Alabama, Kentucky, Georgia, Mississippi, North Carolina, and Virginia. The Tennessee River watershed includes 129 counties and encompasses 40,900 square miles; TVA's Power Service Area comprises 201 counties and covers approximately 80,000 square miles. Analyses of some resource areas (e.g., navigation and air quality) included parts of the Ohio and Mississippi River systems and other areas outside the Valley and TVA Power Service Area to ensure a comprehensive analysis.

ES.5 Issues Considered

The scoping process for the EIS identified a broad range of issues and values to be addressed and alternatives to be evaluated in the ROS. Overall, the public placed a high value on recreation, a healthy environment, production of electricity, flood control, and water supply. After all public feedback was evaluated along with previous input, TVA identified 11 major issues for evaluation in the EIS. Other issues normally addressed in NEPA reviews were also incorporated into the analysis of each policy alternative.

Summary of Issues Raised by Agencies and the Public

Major Issue	Expressed Concerns
Reservoir and downstream water quality	Dissolved oxygen levels, temperature, ammonia levels, wetted area (the area of river bottom covered by water), velocity, algae, and waste assimilation capacity
Environmental resources	Aquatic resources, erosion and sedimentation, visual resources, cultural resources, federally and state-listed species, wetlands, and ecologically sensitive areas
Reservoir levels	Reservoir elevations and the annual timing of fill and drawdown, and their effects on reservoir recreation, property values, and aesthetics.
Recreation flows	TVA's ability to schedule releases for tailwater recreation, including fishing, rafting, canoeing, and kayaking
Economic development	Recreation, property values, navigation, power supply, and water supply
Water supply	Reservoir and downstream intakes and potential interbasin transfers
Navigation	Impacts on channel depth, speed of currents, and water levels
Flood risk on regulated waterways	Available reservoir space for storing floodwaters, how fast space can be recovered after a flood, and costs related to property damage and jobs lost or disrupted
Power reliability	Availability of cooling water at coal-fired and nuclear plants, fuel delivery by barges for coal-fired plants, and restrictions on hydropower production during critical power demands
Cost of power	Hydropower production, including total megawatt hours, seasonal availability, and value during high-cost periods
Capital costs	Changes to reservoir operations, including modifications and upgrades to, as well as additions to and removal of, various structures and equipment

[1] Note: All of TVA's projects and properties are held in custody by TVA and are owned by the United States.

ES.6 Objectives

To define and evaluate policy alternatives, TVA established a set of objectives that incorporate the issues that were identified by the public and interested parties during the scoping phase. TVA also considered other objectives, such as reducing the cost of treating water for municipal and assimilation-capacity uses, maintaining existing dam safety margins, and improving air quality.

OBJECTIVES IDENTIFIED DURING SCOPING FOR THE ROS EIS

- Supplying low-cost, reliable electricity
- Increasing revenue from recreation
- Reducing flood risk and flood-related damages
- Lowering the cost of transporting materials on the commercial waterway
- Providing enough water for municipal, agricultural, and industrial purposes
- Improving recreation on reservoirs and tailwaters
- Improving water quality in reservoirs and tailwaters
- Improving aquatic habitat in reservoirs and tailwaters
- Minimizing erosion of reservoir shoreline and tailwater riverbanks
- Increasing protection for threatened and endangered species
- Protecting and improving wetlands and other ecologically sensitive areas
- Protecting and improving the scenic beauty of the reservoirs

ES.7 Alternatives Considered

The National Environmental Policy Act (NEPA) requires that TVA evaluate a reasonable range of alternatives and the alternative of taking no action. For the purposes of this EIS, a policy alternative refers to a set of system-wide operational changes that would add emphasis to certain operating objectives, such as increased opportunities for recreation, hydropower production, or navigation. To be considered reasonable, an alternative was required to be capable of achieving or substantially achieving TVA's objective of improving the overall public value of its reservoir system; be environmentally, economically, and technically feasible; and provide basic reservoir system benefits (such as flood control).

Eight reservoir operations policy alternatives (seven policy alternatives and the Base Case) were selected for detailed evaluation in this EIS. The following sections summarize the reservoir operations of each policy alternative. The alternative names reflect their primary emphasis, but each alternative was designed to achieve multiple objectives.

ES.7.1 Base Case

As required by NEPA, the Base Case documents the current reservoir operations policy against which the policy alternatives are compared. The Base Case is defined by operating guidelines (guide curves), water release guidelines, and project commitments and constraints for comparing the impacts of the potential range of alternative conditions.

The Base Case also involves a number of other actions that would occur regardless of changes in the reservoir operations policy. These actions include existing water use patterns, taking into account increasing water supply demand in the future (through 2030); modernization and automation of TVA's hydro plants; operation of Browns Ferry Unit 1, and continued operation and uprate of Units 2 and 3; and operation of the Tennessee–Tombigbee waterway at full capacity.

ES.7.2 Reservoir Recreation Alternative A

Reservoir Recreation Alternative A would extend the summer pool period and delay unrestricted drawdown on 10 (South Holston, Watauga, Cherokee, Douglas, Fontana, Chatuge, Nottely, Hiwassee, Blue Ridge, and Norris) of the tributary reservoirs until Labor Day (a month longer than under the Base Case). For Great Falls, the summer fill period would be completed earlier. On six (Watts Bar, Chickamauga, Guntersville, Wheeler, Pickwick, and Kentucky/Barkley) of the mainstem reservoirs, the summer pool period would be extended to August 1 and then reduced by 1 foot from August 1 through Labor Day.

To reduce drawdowns, reservoir releases during the summer pool period would be generally limited to those necessary to meet project and system minimum flow requirements and to maintain flood storage allocation. However, the bi-weekly average releases from Chickamauga Reservoir would be increased and limited to 25,000 cubic feet per second (cfs) weekly average from August 1 to Labor Day, allowing sufficient flow throughout the reservoir system to minimize thermal impacts that result in additional derates of nuclear and fossil power plants located on the reservoirs.

Under Reservoir Recreation Alternative A, the winter flood guide levels would be increased on 10 tributary reservoirs (South Holston, Watauga, Cherokee, Douglas, Chatuge, Nottely Hiwassee, Blue Ridge, Norris, and Tims Ford) to the pool level targeted to be reached by March 15 under the Base Case. On five mainstem reservoirs (Fort Loudoun, Watts Bar, Chickamauga, Wheeler, and Pickwick), the minimum winter elevation would be raised by 2 feet, and the typical 2-foot winter fluctuating zone under the Base Case would be reduced to 1 foot for these five mainstem reservoirs under Reservoir Recreation Alternative A.

PROCESS FOR DEVELOPMENT OF ALTERNATIVES

- Conducted public outreach to identify public's preferred reservoir operations priorities
- Compiled comments received during public scoping about suggested changes to the reservoir operations policy
- Identified major and minor issues
- Compiled operating options suggested by the public
- Developed 65 preliminary alternatives
- Screened and evaluated the 65 preliminary alternatives
- Eliminated from further consideration those alternatives that did not meet operating objectives or were not feasible
- Formulated condensed set of 25 preliminary alternatives
- Obtained IAT/PRG review and comment on the 25 preliminary alternatives
- Revised initial set of 25 preliminary alternatives and developed a refined set of 25 alternatives
- Modeled the second set of 25 alternatives to confirm technical and economic feasibility
- Screened and narrowed the number of alternatives to be considered by combining similar alternatives and bounding the range of possibilities
- Selected eight alternatives for further consideration (the Base Case and seven policy alternatives)
- Reexamined the eight alternatives to determine whether any additional operating objectives or policy elements should be included
- Confirmed selected eight alternatives for detailed analysis

ES.7.3 Reservoir Recreation Alternative B

Reservoir Recreation Alternative B is similar to Reservoir Recreation Alternative A. As under Reservoir Recreation Alternative A, targeted summer pool levels would be extended to Labor Day on 10 tributary reservoirs by delaying the beginning of unrestricted drawdown to Labor Day. On six of the mainstem reservoirs, the summer pool elevations would be extended to Labor Day (as compared to August 1 under Reservoir Recreation Alternative A). In contrast to Reservoir Recreation Alternative A, Reservoir Recreation Alternative B would have no allowance for mainstem drawdown until Labor Day.

For Reservoir Recreation Alternative B, the method of flood storage allocation would be changed to provide adequate storage for the 7-day, 500-year inflow[2]. Reservoir releases would be limited to only minimum flows from June 1 to Labor Day. Chickamauga Reservoir minimum releases would remain at 13,000 cfs (the Base Case).

In most cases, winter reservoir levels on tributary reservoirs would be higher, but by an amount that would vary among reservoirs depending on storage needed for the 7-day, 500-year inflow. On mainstem reservoirs, the minimum winter elevation would be raised 2 feet where possible. The typical 2-foot winter fluctuating zone under the Base Case would be reduced to 1 foot for these mainstem reservoirs under Reservoir Recreation Alternative B.

ES.7.4 Summer Hydropower Alternative

Under the Summer Hydropower Alternative, unrestricted drawdown would begin immediately after June 1 to increase power production and flood storage volume on both tributary and mainstem reservoirs.

For the Summer Hydropower Alternative, the method of flood storage allocation would be revised to provide adequate storage for inflow for the 7-day, 500-year storm, allowing flood guides on tributary reservoirs to be raised in some cases. Weekly average releases from Chickamauga Reservoir would be increased to 35,000 cfs (compared to 13,000 cfs bi-weekly average under the Base Case). No tailwater releases would be made for recreation, except Ocoee #2 Reservoir.

ES.7.5 Equalized Summer/Winter Flood Risk Alternative

The principal changes to system operations would involve establishing year-round flood guides for tributary and mainstem reservoirs that would vary by reservoir and month, depending on the seasonal runoff. These flood guides would be based on a reservoir's capacity to store inflow from the critical-period, 500-year storm[3] and would equalize the level of flood risk in all seasons.

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[2] The 7-day, 500 year flood storage allocation for a given reservoir is the flood storage volume required to store the maximum 7-day average local inflow for a storm with a probability of occurrence in any given year of 0.002 (commonly referred to as the 500-year flood).

[3] The critical-period, 500-year storage for a given reservoir is the maximum storage volume required to store the inflow from a storm, with a probability occurrence in any given year of 0.002 (commonly referred to as the 500-year storm). The storage volume required for a specific reservoir also takes into account the reservoir's natural inflow/discharge and inflows from upstream projects.

A year-round flood guide would generally result in increased winter reservoir levels and reduced summer reservoir levels, in comparison to the Base Case.

Reservoir releases from June 1 to Labor Day would be limited to only those necessary to maintain minimum flows. Releases from Chickamauga Reservoir would be increased from the 13,000-cfs bi-weekly average under the Base Case to a 25,000-cfs weekly average from August 1 to Labor Day under the Equalized Summer/Winter Flood Risk Alternative.

ES.7.6 Commercial Navigation Alternative

Under the Commercial Navigation Alternative, changes to operations would primarily affect mainstem reservoirs. Raising the winter flood guides by 2 feet on mainstem reservoirs, where possible, would increase the navigation channel depth to 13 feet (providing an 11-foot navigation channel with a 2-foot overdraft). The mainstem winter operating range would be modified from 2 feet to allow only a 1-foot fluctuation on those mainstem reservoirs raised 2 feet in winter.

To further support navigation operations, minimum flows would be increased at several key lower river projects with major navigation locks. Specific instantaneous minimum flows, would be provided at Kentucky, Pickwick, and Wilson Reservoirs to reduce the difficulty of navigation at certain locations. At Pickwick and Wilson, these flows would also be tied to pool elevation. A limitation to maximum flow (except in high-flow or flood control situations) would be imposed at Barkley Reservoir, when practical, to reduce high-flow navigation hindrances.

ES.7.7 Tailwater Recreation Alternative

Under the Tailwater Recreation Alternative, tailwater recreation releases would have higher priority than maintaining water levels for reservoir recreation. This alternative would include extending the summer pool period to Labor Day; changing winter tributary flood guides to the 7-day, 500-year storm inflow; and raising winter mainstem reservoir levels by 2 feet, where possible. From June 1 to Labor Day, two types of reservoir releases would occur. Releases would be made to maintain minimum flows, and additional releases would be scheduled to support tailwater recreational opportunities at a number of specific projects (Norris, Watauga/Wilbur, Apalachia, Ocoee #1, and South Holston). Under the Tailwater Recreation Alternative, these releases would be more predictable than under the Base Case.

ES.7.8 Tailwater Habitat Alternative

For this alternative, the principal change to system operations would involve retaining 75 percent of reservoir inflow to maintain reservoir elevations and releasing Base Case minimum flows, or 25 percent of the inflow, whichever is greater, as a relatively continuous minimum flow with no turbine peaking. Hydroturbine pulsing would continue to be used to provide minimum flows. Minimum Operations Guides (MOGs) would be eliminated on tributary reservoirs. Tributary and mainstem reservoirs would use guide curves similar to the ones used

under Reservoir Recreation Alternative A. Mainstem winter operating ranges would be limited to 1 foot for those projects raised 2 feet in winter.

ES.8 Other Actions Considered

TVA also considered a number of other possible actions during formulation of the policy alternatives. They included actions that could be implemented independent of changes in reservoir operations policy such as continuing operation of the Bear Creek and Normandy projects under current guide curves, changes in hydroturbine ramping rates, and operations to support fish spawning and improve habitat and biodiversity. TVA considered but did not include a number of other actions. They included structural modifications to dams, levee construction, maintaining summer reservoir levels year round, reducing minimum flows from tributary dams or filling tributary reservoirs by March 1, and delaying drawdown until after October. Other actions considered but not included in any of the policy alternatives were providing recreational flows on the Ocoee River, reducing the navigation channel to 9 feet or dredging the navigation channel, strengthening TVA's regulatory authority, and constructing or relying on new alternative energy sources and incentives for energy and water conservation. Some of these actions were not within the overall scope of the ROS or have been considered in previous TVA studies.

TVA may augment minimum flow up to 25 cfs from the dam in the 13-mile reach of the Hiwassee River between Apalachia Dam and the Apalachia Powerhouse to enhance the diversity of aquatic species in that waterbody. The augmented flow would increase the amount of, and improve the quality of, the habitats for aquatic life that exists or could be introduced to this part of the Hiwassee River.

ES.9 Potential Impacts and Comparison of Alternatives

Identifying and quantifying the trade-offs between competing reservoir operating objectives were essential to evaluating the policy alternatives. TVA performed a comprehensive environmental and economic evaluation of each of the policy alternatives. Three separate evaluations were performed, one with respect to the objectives identified during from the public scoping process, a second to evaluate impacts to each of the environmental resources, and a third to calculate regional economic benefits.

ES.9.1 Objectives Identified during Scoping

The 12 operating objectives identified during scoping are discussed in Section ES.6. Table ES-01 shows the performance for each of the policy alternatives selected for evaluation in relation to those objectives. This table summarizes how each of the alternatives addresses the identified objectives, based on TVA's analysis documented in the EIS.

Table ES-01 Summary of Policy Alternative Performance by Objectives Identified during Public Scoping

Objective	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Supplying low-cost/reliable electricity [1]	Base	$30 million Increase <1%	$67 million Increase <1%	$3 million No change	$108 million Increase 1.3%	[$11 million] No change	$66 million Increase <1%	$295 million Increase 3.5%
Increasing revenue from recreation [2]	65.1 (base)	$11 million Increase 17%	$14 million Increase 22%	[$10 million] Decrease 15%	$1 million Increase 2%	[$1 million] Decrease 2%	$14 million Increase 22%	$13 million Increase 20%
Reducing flood risk and flood-related damages	No change	Increase	Substantial increase	Increase	Slight decrease	Increase	Substantial increase	Substantial increase
Lowering the cost of transporting materials on the commercial waterway [3]	426 (base)	0	0	[12] Decrease 3%	[1] Decrease <1%	17 Increase 4%	0	0
Providing enough water for municipal, agricultural, and industrial purposes [4]	Base	0	0	12.5	0	3.4	0	0
Improving recreation on reservoirs and tailwaters [5]	6.57 million user days (base)	1.34 million user days Increase 20%	1.54 million user days Increase 24%	[1.27 million] user days Decrease 19%	0.24 million user days Increase 4%	[0.12 million] user days Decrease 1.9%	1.55 million user days Increase 23%	1.44 million user days Increase 22%
Improving water quality in reservoirs and tailwaters	Variable year to year – no change	Slightly adverse to adverse	Slightly to substantially adverse	Adverse to beneficial	No change to adverse	No change to slightly beneficial	No change to substantially adverse	Adverse
Improving aquatic habitat in reservoirs and tailwaters	No change	Slightly adverse to slightly beneficial	Slightly adverse to slightly beneficial	Slightly adverse to slightly beneficial	Slightly adverse to slightly beneficial	Slightly beneficial	Adverse to slightly beneficial	No change to adverse
Minimizing erosion of reservoir shoreline and tailwater riverbanks	No change	Slightly adverse	Slightly adverse	No change to slightly beneficial	No change to slightly beneficial	No change	Slightly adverse	Slightly adverse to adverse
Increasing protection for threatened and endangered species	No change	No change to slightly adverse	No change to slightly adverse	Adverse	No change to slightly beneficial	No change to slightly beneficial	No change to slightly adverse	Beneficial to slightly adverse

Table ES-01 Summary of Policy Alternative Performance by Objectives Identified during Public Scoping (continued)

Operating Objective	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Protecting and improving wetlands and other ecologically sensitive areas	No change	Slightly adverse to slightly beneficial	Adverse to slightly beneficial	Substantially adverse	Adverse to substantially adverse	No change	Slightly adverse to slightly beneficial	Slightly adverse to slightly beneficial
Protecting and improving the scenic beauty of the reservoirs	No change	Beneficial	Substantially beneficial	Adverse	Slightly adverse	Slightly beneficial	Substantially beneficial	Substantially beneficial

Notes:

Brackets indicate negative values.
Light shading indicates substantially beneficial performance; dark shading indicates substantially adverse performance.

[1] In millions of dollars annually/percent of total TVA revenue for 2010 in 2002 dollars.

[2] Changes in recreational expenditures from outside the TVA region in millions of dollars annually for the year 2010 in 2002 dollars.

[3] Change in shipper savings in millions of dollars annually/percent for 2010 in 2002 dollars.

[4] Cost to modify intakes on reservoirs with pool levels below TVA-published minimum elevations (dollars in millions in 2002 dollars).

[5] Total recreation use (user days).

ES.9.2 Impacts on Resource Areas

At a more detailed level, TVA analyzed 24 resource areas that reflect a wide range of issues important to the residents of the Tennessee River basin. Table ES-02 presents the effects of the policy alternatives on each of these resource areas.

This assessment of impact was made using seven impact levels, including No Change, Slightly Adverse/Slightly Beneficial, Adverse/Beneficial, and Substantially Adverse/Substantially Beneficial. The extent, duration, and intensity determine the level of impact. For some resource areas, the impact was listed as Variable because the effects of an alternative varied across the study area to a degree that they could not be classified within a single impact level.

DEFINITIONS OF IMPACT

Level of Impact	Description
No change	Impact on the resource area is negligibly positive or negative but is barely perceptible or not measurable, or confined to a small area; or the extent of the impact is limited to a very small portion of the resource.
Slightly adverse/slightly beneficial	Impact on the resource area is perceptible and measurable, and is localized, or its intensity is minor but over a broader area and would not have an appreciable effect on the resource. This also can refer to impacts that would be short in duration and not recurring.
Adverse/beneficial	Impact is clearly detectable and could have an appreciable effect on the resource area. Moderate impacts can be caused by combinations of impacts, ranging from high-intensity impacts over a smaller area to small to moderate impacts over a larger area. This also can occur with minor to moderate impacts that are recurring over a period of years.
Substantially adverse/ substantially beneficial	Impact would result in a major, highly noticeable influence on the resource area, generally over a broader geographic extent and/or is recurring for many years.

Reservoir Recreation Alternative A—Reservoir Recreation Alternative B—Tailwater Recreation Alternative—Tailwater Habitat Alternative

These alternatives are similar in that they would produce substantial benefits for recreational use of the reservoirs, substantially increased visual quality, and other beneficial resource improvements. However, these alternatives would also result in water quality impacts that would affect aquatic resources (and in some cases threatened and endangered aquatic species), increase erosion and related impacts on cultural resources, and adversely affect water supply. As a group, they represent a mixed set of impacts on environmental resources.

Table ES-02 Summary of Impacts by Policy Alternative

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Air Resources								
Air emissions	No change	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly adverse	No change	Slightly adverse	Slightly adverse
Climate								
Greenhouse emissions	No change	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly adverse	Beneficial
Water Quality								
Assimilative capacity – storage tributaries	No change	Slightly beneficial	Slightly beneficial	Variable	No change	No change	Slightly beneficial	Beneficial
Assimilative capacity – transitional tributaries[1]	No change	No change to slightly adverse	No change	No change to slightly adverse	Slightly adverse	No change	No change	No change to slightly adverse
Assimilative capacity –mainstem reservoirs	No change	No change	No change	No change	No change	No change	No change	No change
Anoxia – storage tributaries	No change	Slightly adverse	Slightly adverse	Variable	No change to slightly beneficial	No change	No change to slightly adverse	Adverse
Anoxia – transitional tributaries	No change	Slightly adverse	Slightly adverse	Slightly beneficial	No change to slightly adverse	No change	Slightly adverse	No change to slightly adverse
Anoxia – mainstem reservoirs	No change	Adverse	Substantially adverse	Substantially beneficial	Adverse	No change to slightly beneficial	Substantially adverse[2]	Adverse

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Water Supply								
Water supply delivery (costs)	No change	Beneficial	Beneficial	Adverse	Slightly Beneficial	Slightly Adverse	Beneficial	Slightly Beneficial
Water supply quality (treatment)	No change	Slightly adverse	Slightly adverse to adverse	No change	Slightly adverse	No change	Slightly adverse to adverse	Slightly adverse to adverse
Groundwater Resources								
Groundwater levels	No change	Slightly beneficial	Slightly beneficial	Slightly adverse	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial
Aquatic Resources								
Biodiversity – tributary reservoirs	No change	No change	No change to slightly adverse	Adverse	No change	No change	No change to slightly adverse	Slightly adverse
Biodiversity – mainstem reservoirs	No change	Slightly adverse	Slightly adverse	Slightly beneficial	No change to slightly adverse	Slightly beneficial	Slightly adverse	Adverse
Biodiversity – warm-water tailwaters[3]	No change	No change to slightly adverse	No change to slightly adverse	Adverse	No change	No change	No change to slightly adverse	No change
Sport fish – tributary reservoirs	No change	No change to slightly beneficial[4]	Slightly beneficial[4]	Variable[3]	Slightly adverse	No change to slightly beneficial	Slightly beneficial[4]	Slightly adverse
Sport fish – mainstem reservoirs	No change	No change to slightly adverse	No change to slightly adverse	No change to slightly beneficial	Slightly adverse	No change to slightly beneficial	No change to slightly adverse	Slightly adverse

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Aquatic Resources (continued)								
Sport fish – warm-water tailwaters	No change	No change	No change to slightly beneficial	Slightly beneficial	Variable[3]	No change	No change to slightly beneficial	Variable[3]
Sport fish – cold-water tailwaters	No change	Slightly beneficial	Slightly beneficial	Adverse	Variable[3]	No change	Slightly beneficial	Variable[3]
Commercial fish – reservoirs	No change	Adverse	Adverse	Beneficial	Slightly adverse to adverse	No change	Adverse	Adverse
Wetlands								
Location	No change	Slightly beneficial	Slightly beneficial to beneficial	Substantially adverse	Substantially adverse	No change	Slightly beneficial to beneficial	Slightly beneficial
Type	No change	Slightly adverse (variable)	Adverse (variable)	Substantially adverse	Adverse to substantially adverse	No change	Adverse (variable)	Slightly adverse (variable)
Function	No change	Slightly beneficial	Slightly beneficial	Substantially adverse	Substantially adverse	No change	Slightly beneficial	Slightly beneficial
Aquatic Plants[5]								
Tributary reservoirs	No change	Slight increase	Slight increase	Slight decrease	Variable	No change	Slight increase	Slight increase
Mainstem reservoirs	No change	No change	No change	Substantial decrease	No change	No change	No change	No change

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Terrestrial Ecology								
Migratory shorebirds	No change	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse	Adverse
Wildlife	No change	Slightly beneficial	Slightly beneficial	Adverse	Slightly beneficial	Slightly beneficial	Slightly beneficial	Slightly beneficial
Plant communities	No change	Slightly adverse	Adverse	Substantially adverse	Adverse	Slightly adverse	Adverse	Slightly adverse
Invasive Plants and Animals								
Population abundance and spread of invasive species[6]	No change	Slightly adverse	Slightly adverse	Adverse	Slightly adverse	Slightly adverse	Slightly adverse	Adverse
Vector Control								
Population abundance	No change	Slightly adverse	Slightly adverse	Beneficial	Slightly adverse	No change	Slightly adverse	Slightly adverse
Threatened and Endangered Species								
Tributary reservoirs	No change	No change to slightly adverse	No change to slightly adverse	Substantially adverse[7]	Slightly beneficial to variable[8]	No change	No change to slightly adverse in a few areas	Beneficial
Mainstem reservoirs	No change	No change to slightly adverse	No change to slightly adverse	Slightly beneficial to beneficial	Slightly adverse	Slightly beneficial	No change to slightly adverse	No change to slightly adverse
Shorelines and lowlands	No change	Adverse	Adverse	Adverse	Adverse	Beneficial	Adverse	Adverse
Uplands	No change	No change	No change	No change	No change	No change	No change	No change
Apalachia Bypass	No change	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial	Beneficial

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Threatened and Endangered Species (continued)								
Wide-ranging species	No change	Beneficial	Beneficial	Adverse	No change	Beneficial	Beneficial	Beneficial
Upstream from impoundments	No change	No change	No change	No change	No change	No change	No change	No change
Cave aquifers	No change	No change	No change	No change	No change	No change	No change	No change
Managed Areas and Ecologically Sensitive Sites								
Integrity of sites	No change	Slightly adverse to slightly beneficial	Slightly adverse	Adverse	Adverse	No change	Slightly adverse	Slightly adverse to slightly beneficial
Shoreline Development and Land Use								
Indirect effect on natural condition	No change	Slightly adverse	Slightly adverse	Slightly beneficial	No change to slightly beneficial	No change	Slightly adverse	No change to slightly adverse
Shoreline Erosion								
Reservoir effects	No change	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial	No change	Slightly adverse	Adverse
Tailwater effects	No change	Slightly adverse	Slightly adverse	No change	No change	No change	Slightly adverse	Slightly adverse
Prime Farmland								
Conversion of prime farmland	No change	Slightly adverse	Slightly adverse	Slightly beneficial	Slightly beneficial	No change	Slightly adverse	Slightly adverse

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Cultural Resources								
Indirect effects	No change	Adverse	Adverse	Slightly beneficial	Slightly beneficial	No change	Adverse	Slightly adverse
Direct effects	No change	Adverse	Slightly adverse	Slightly beneficial	Slightly beneficial	No change	Slightly adverse	Slightly adverse
Visual Resources								
Scenic integrity	No change	Beneficial	Substantially beneficial	Adverse	Slightly adverse	Slightly beneficial	Substantially beneficial	Substantially beneficial
Dam Safety								
Reservoir-induced seismicity	No change	No change	No change	No change	No change	No change	No change	No change
Leakage	No change	No change	No change	No change	No change	No change	No change	No change
Design flood maximum reservoir levels	No change	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse	Slightly adverse
Navigation								
Change in annual shipper savings[9]	No change	0	0	[$12 million]	[$1 million]	$17 million	0	0
Flood Control								
Peak discharge–historical inflows	No change	Adverse	Substantially adverse	Adverse	Slightly adverse	Adverse	Substantially adverse	Substantially adverse
Peak discharge–design storms	No change	Adverse	Substantially adverse	Adverse	Slightly adverse	Adverse	Substantially adverse	Substantially adverse

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Flood Control (continued)								
Potential damage	No change	Adverse	Substantially adverse	Adverse	Slightly beneficial	Adverse	Substantially adverse	Substantially adverse
Power								
Change in annual power cost[9]	No change	$30 million	$67 million	$3 million	$108 million	[$11 million]	$66 million	$295 million
Recreation[9,10]								
Change in annual recreation spending	No change	$11 million	$14 million	[$10 million]	$1 million	[$1 million]	$14 million	$13 million
Public access site use in reservoirs	No change	Slightly beneficial to beneficial	Beneficial	Slightly adverse to adverse	Slightly adverse	No change	Beneficial	Beneficial
Public access site use in tailwaters	No change	Slightly beneficial	Slightly beneficial to beneficial	Adverse	Adverse	No change	Slightly beneficial to beneficial	No change
Commercial site use[11]	No change	Slightly beneficial to beneficial	Beneficial	Slightly adverse to adverse	Slightly beneficial	No change	Beneficial	Beneficial
Private access site use	No change	Beneficial	Beneficial	Adverse	Slightly beneficial	No change	Beneficial	Beneficial

Table ES-02 Summary of Impacts by Policy Alternative (continued)

Resource Area	Alternative							
	Base Case	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Social and Economic Resources[12]								
Gross regional product[9]	No change	[$13.6 million] Slightly adverse	[$32.5 million] Slightly adverse	[$43.2 million] Slightly adverse	[$76.5 million] Slightly adverse	$54.0 million Slightly beneficial	[$30.8 million] Slightly adverse	$160.8 million Slightly adverse
Personal income[9]	No change	[$4.4 million] Slightly adverse	[$11.5 million] Slightly adverse	[$14.6 million] Slightly adverse	[$31.1 million] Slightly adverse	$15.8 million Slightly beneficial	[$10.9 million] Slightly adverse	[$63.7 million] Slightly adverse
Employment	No change	[660] Slightly beneficial	[220] Slightly beneficial	[413] Slightly adverse	[745] Slightly adverse	408 Slightly beneficial	[201] Slightly beneficial	[1,522] Slightly adverse
Population	No change	[392] Slightly adverse	[769] Slightly adverse	[372] Slightly adverse	[1,571] Slightly adverse	405 Slightly beneficial	[745] Slightly adverse	[3,518] Slightly adverse

Note: Brackets indicate negative values.

[1] Transitional reservoirs are so categorized because they are unique cases that do not include all of the general characteristics of mainstem or tributary reservoirs described in Section 3.5. They include Boone, Fort Patrick Henry, Tellico, Apalachia, and Melton Hill Reservoirs.

[2] Results in large volume of water with low dissolved oxygen.

[3] Cold-water tailwaters are not included because resident communities are minimal due to the cold-water releases, and no alternative would change this general condition. Variable response indicates that conditions for this resource would change differently across the locations assessed.

[4] Except for cold-water and cool-water species, which would be slightly adversely affected.

[5] A change in coverage includes either an increase or a decrease in the number of plant acres. Changes can be seen as adverse or beneficial, depending on the reader's perspective.

[6] Terrestrial plants and animals and aquatic animals.

[7] Substantially adverse because of low flows in June and July.

[8] No consistent pattern in Cherokee Dam tailwater.

[9] Represents 2002 dollars in 2010.

[10] Impacts are reported for the months of August, September, and October—the months for which the recreation analysis was completed.

[11] Commercial whitewater rafting activity on Ocoee # 2 and Ocoee # 3 is considered in this summary. Under the Summer Hydropower Alternative and the Tailwater Habitat Alternative, commercial whitewater releases would be suspended on Ocoee # 3. For purposes of this summary, it was assumed that this would result in the closure of commercial whitewater activities on Ocoee #3.

[12] Annual changes – 2010.

This group of alternatives would change, to various degrees, reservoir levels and flows through the reservoir system and their seasonal timing. These are the major factors driving the level of beneficial or adverse impact on aquatic systems, wetland systems, and shoreline conditions, and the frequency and duration of thermal plant derates. Higher reservoir levels and reduced flows through the system would result in a suite of adverse and beneficial changes to the reservoir system. These would include some complex inter-connected changes in the environment.

Holding summer pool levels higher later into summer and fall would result in increased thermal stratification in some reservoirs and in decreased water quality, low DO conditions, and anoxia—depending on the reservoir. Decreased water quality would adversely affect aquatic resources and, at specific locations, threatened and endangered species. It would be costly to mitigate for the water quality impacts resulting in low DO in project releases, and some impacts may be unavoidable.

Within this group of alternatives, Reservoir Recreation Alternative B and the Tailwater Habitat Alternative would result in the most adverse impact on water quality because they would maintain summer pool levels longer and/or reduce flow through the system in summer to a greater extent. Reservoir Recreation Alternative A and the Tailwater Recreation Alternative would result in the largest impacts on water quality conditions in mainstem reservoirs. Reservoir Recreation Alternative A would achieve recreational and aesthetic benefits without the more substantial water quality impacts that accompany the Reservoir Recreation Alternative B, the Tailwater Recreation Alternative, and the Tailwater Habitat Alternative.

Maintaining summer pool levels longer would result in greater potential for shoreline erosion, with associated adverse effects on cultural resources and some shoreline habitats. Under all these alternatives, increased erosion would occur and would be greatest under the Tailwater Habitat Alternative. Impacts on cultural resources under these alternatives would be adverse.

The alternatives in this group would result in variable and slightly adverse impacts on wetlands overall, because they would change the timing of inundation of various wetland, lowland, and shallow-water habitats. Reservoir Recreation Alternative B would result in more adverse impacts than the others, largely due to the inundation of flats habitats later into summer and fall when these habitats are important to migratory waterfowl and shorebirds.

Summer Hydropower Alternative—Equalized Summer/Winter Flood Risk Alternative

These alternatives are similar in that they would produce few overall beneficial or substantially beneficial environmental effects within the TVA reservoir system but would produce a number of substantial adverse environmental effects. Recreation use is projected to change little under the Equalized Summer/Winter Flood Risk Alternative but would decline substantially under the Summer Hydropower Alternative. Reservoir recreation revenues would show this pattern, and visual quality of the reservoirs would show corresponding small to moderate declines, respectively.

Several environmental resources would be adversely affected, especially under the Summer Hydropower Alternative. Both the Summer Hydropower Alternative and the Equalized Summer/Winter Flood Risk Alternative would result in moderate or substantial impacts on wetland resources and would result in greater shoreline erosion. The Summer Hydropower Alternative would result in additional adverse environmental impacts on water quality in some tributary reservoirs, adverse impacts on threatened and endangered species, and water supply withdrawal structures and pumping costs.

Base Case—Commercial Navigation Alternative

These alternatives are similar in the fact that they would produce fewer beneficial or adverse changes within the TVA system. The Commercial Navigation Alternative would increase shipper savings and result in some adverse impacts on terrestrial ecology (use of flats and some bottomland hardwood wetlands) but would otherwise result in little environmental change from what would occur under the Base Case.

ES.9.3 Regional Economic Effects

In 2000, the ROS area population was 9.2 million, total employment was 5.4 million jobs, total personal income was $235 billion, and gross regional product (GRP) was $275 billion (2002 dollars). The region attained these levels after strong growth over the 1990s, outpacing national economic growth. Gross regional product, population, employment, and income in the region grew at a faster rate than their national counterparts during the same period.

Under the Base Case, the regional economic growth is projected to continue to outpace national economic growth over the rest of the decade. Overall, the region is projected to experience a gross regional product increase of 3.2 percent per year, compared to 3.0 percent nationally, from 2000 to 2010. Total employment is forecasted to grow at 1.2 percent while increasing at 1.0 percent nationally. With this job growth and with the region remaining a desirable place to live, regional population is also expected to continue to outpace national growth, increasing at 1.1 percent per year versus 1.0 percent for the nation.

To determine the economic effects of an alternative reservoir operations policy as compared to the Base Case, TVA evaluated several economic parameters. This evaluation integrated changes to the cost of power, revenues from recreation, shipper savings from river transportation, cost of municipal water supplies, and changes in property values into a measure of overall effects on the regional economy. Table ES-03 shows the effect of each of the reservoir operations policy alternatives as measured by change (from Base Case) in the gross regional product (GRP), the sum dollar value of all goods and services in the economy that is commonly used as a broad measure of economic activity. The GRP includes both direct economic effects, such as changes in power costs, and also includes the ripple effect of changed power costs on other economic sectors.

Table ES-03 Annual Economic Effects of Policy Alternatives Based on Changes in Gross Regional Product (2010)

	Reservoir Recreation A	Reservoir Recreation B	Summer Hydropower	Equalized Summer/ Winter Flood Risk	Commercial Navigation	Tailwater Recreation	Tailwater Habitat
Change	[$13.6 million]	[$32.5 million]	[$43.2 million]	[$76.5 million]	$54.0 million	[$30.8 million]	[$160.8 million]
Percent of gross regional product	-0.004	-0.01	-0.012	-0.02	0.02	-0.01	-0.43

Note: Brackets indicate negative values.

As measured by the GRP, only the Commercial Navigation Alternative is expected to positively affect the regional economy. All other alternatives are expected to result in a negative regional economic effect. The actual magnitude of these effects, either negative or positive, would be extremely small as a percent of the GRP. Effects for 2010 are shown in Table ES-03. The impacts for 2010 represent the effects after changes to the operations policy have been absorbed into the regional economy.

Changes in power costs are predicted to be in the range of 1 percent or less. Other sectors, however, may experience greater changes. The one sector of direct economic effects that would increase for most alternatives is the change in recreation revenue. All of the alternatives that include increased recreation benefits would increase revenue approximately 20 percent. The Equalized Summer/Winter Flood Risk Alternative and the Commercial Navigation Alternative would result in negative revenues while the Summer Hydropower Alternative would result in no change in revenues. In another category, shipper savings may be increased by 4 percent under the Commercial Navigation Alternative. (See Table ES-01.)

ES.9.4 Development of a Preferred Alternative

TVA's evaluation of the policy alternatives indicates that there may be sufficient flexibility and robustness in the TVA system to rebalance system operations policy in order to achieve greater overall public value. Analyses suggest that this may be possible without resulting in unacceptable environmental impacts, but flood damage and power costs could increase. Changing the current balance among objectives would involve definite tradeoffs.

A reduction in flood storage capacity in Kentucky Reservoir would affect operation of Barkley Reservoir, a project operated by the USACE. These two projects must be operated as a single unit because a canal connects Barkley and Kentucky Reservoirs. Further, under the Flood Control Act of 1944, USACE has the authority to direct TVA's operation of Kentucky Reservoir during flood control operations on the lower Ohio and Mississippi Rivers. The storage capacity in these two reservoirs has the potential to provide significant flood reduction benefits on the lower Ohio and Mississippi Rivers. As a result, the USACE's position is that they cannot

endorse or implement any changes to Kentucky/Barkley operations policies without further detailed studies, both for Barkley Reservoir and downstream on the lower Ohio and Mississippi Rivers. The USACE presently has no authorization or funding for these studies.

TVA has not identified a preferred alternative at this time. Because public desires and values play an important role in the evaluation of the identified alternatives, TVA wants the benefit of additional public input on the alternatives before a preferred course of action is identified for recommendation to the Board. The Final EIS will identify TVA's preferred alternative.

This EIS discusses a programmatic approach to avoiding or minimizing impacts associated with various alternatives. Most importantly, TVA is, to the extent possible, designing reservoir operations policy alternatives to avoid or minimize potential impacts in the first instance. Refinement of alternatives is expected to continue as TVA considers suggestions from the public and other resource agencies. Action-specific mitigation measures that TVA chooses to implement will depend on what, if any, changes are made to TVA's operations policy and will be identified in TVA's Record of Decision at the end of the NEPA process.